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EXAMINER

GUILL, RUSSELL L

ART UNIT	PAPER NUMBER
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2123

DATE MAILED: 02/21/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/099,721

Applicant(s)

JAMES, GREGORY E.

Examiner

Russell L. Guill

Art Unit

2123

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 November 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-31 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-31 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 14 March 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____

DETAILED ACTION

1. This Office Action is in response to an Amendment filed November 14, 2005. Claims 1, 27, 28 and 29 were amended. No claims were canceled or added. Claims 1 – 31 are pending. 1 – 31 have been examined. Claims 1 – 31 have been rejected.
2. The Examiner notes that two separate editions of the reference by Press are cited in this action.

Response to Remarks

3. Regarding claims 1, 26 and 27 rejected under 35 USC § 112, second paragraph:
 - a. Applicant's arguments, see page 7, have been fully considered and are persuasive. Accordingly, the rejections are withdrawn.
4. Regarding claims 1 - 31 rejected under 35 USC § 102(e):
 - a. Applicant's arguments, see pages 7 - 10, have been fully considered and are persuasive. Accordingly, the rejections are withdrawn. However, upon further consideration, a new ground(s) of rejection is made as detailed below.

Background

5. It was old and well known in the art at the time of invention to use graphics hardware programming to solve non-graphics problems (Kedem, 1999; and Lengyel, 1990; and Bohn, 1998), including physical simulations (Ide, et al.; 2000), because of the superior speed of processing on graphics hardware. As demonstrated in the previously mentioned references, it was old and well known in the art to implement known algorithms on faster processors when they became available, and indeed, that is the reason that faster processors are developed. It was also old and well known in the art at the time of invention to solve partial differential equations that represent physical problems, by using numerous methods, using computer processing (Press, et al.; 1988). Graphics hardware was used to compute solutions to a partial differential equation for visualization of flows (Harris, 2002, referring to cited earlier references).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 1 - 2, 12 - 18, 22 - 23 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Press (Press, William H.; Flannery, Brian P.; Teukolsky, Saul A.; Vetterling, William T.; "Numerical Recipes in Fortran 77", 2001, Second edition, Cambridge University Press) in view of Trendall (Trendall, Chris; Stewart, A. James; "General Calculations using graphics hardware, with application to interactive caustics", June 2000, "Rendering Techniques 2000: 11th Eurographics Workshop on Rendering").

a. Regarding claim 1:

b. Press appears to teach:

i. Receiving input (pages 854-856, section 19.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that input is required to solve a partial differential equation, especially given the statement that an initial distribution relaxes to an equilibrium distribution on page 855);

ii. Processing the input to generate the solution to the partial differential equation (pages 854-856, section 19.5 Relaxation Methods for Boundary Value Problems);

c. Press does not specifically teach:

i. Receiving input in the hardware graphics pipeline;

ii. Processing the input to generate the solution to the partial differential equation utilizing the hardware graphics pipeline;

d. Trendall appears to teach:

i. Receiving input in the hardware graphics pipeline (page 9, section 5 Implementation results, first paragraph; page 7, second paragraph that starts with "Since the imaging pipeline . . ."; it would have been obvious that in order for the pipeline to perform a convolution that input was received);

ii. Processing the input to generate the solution to the partial differential equation utilizing the hardware graphics pipeline (page 1, Title; page 1, Abstract; page 1, section 1 Introduction; page 8, section 4.2 Hardware Algorithm; and page 2, section 2.2 Refractive Caustics; the solution of the caustic is a solution to an electromagnetic field problem described by a partial differential equation);

e. The motivation to use the art of Trendall with the art of Press would have been the benefit recited in Trendall that calculations on functions or vector fields can be performed very quickly in graphics hardware (page 3, section 3 Mathematical capabilities of graphics hardware, third paragraph).

f. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Trendall with the art of Press to produce the claimed invention.

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g. Regarding claim 2:

h. Press appears to teach:

i. Input represents boundary conditions (pages 854-856, section 19.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that boundary conditions are required to solve a partial differential equation, especially since the title of the section recites Boundary Value problems);

=====

i. Regarding claim 12:

j. Press appears to teach:

i. The processing includes a relaxation operation (pages 854-856, section 19.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that processing includes a relaxation operation, especially since the title of the section recites Relaxation Methods);

=====

k. Regarding claim 13:

l. Press appears to teach:

- i. The relaxation operation is selected based on the partial differential equation (pages 854-856, section 19.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that the relaxation operation is selected based on the partial differential equation, especially since such an example is presented);
- =====

m. Regarding claim 14:

n. Press appears to teach:

- i. The processing includes a plurality of iterations of the relaxation operation (pages 854-856, section 19.5 Relaxation Methods for Boundary Value Problems; especially references to Gauss-Seidel method and Jacobi's method);
- =====

o. Regarding claim 15:

p. Press appears to teach:

- i. A number of iterations of the relaxation operation is reduced using at least one of a prolongation operation and a restriction operation (pages 862-868, section 19.6 Multigrid Methods for Boundary Value Problems, especially page 865 Smoothing, Restriction and Prolongation Operators);
- =====

q. Regarding claim 16:

r. Press appears to teach:

- i. The processing further includes determining whether the solution has converged (pages 855, Relaxation Methods for Boundary Value Problems; second paragraph, section that starts with "Thus the algorithm consists . . .", sentence, "This procedure is then iterated until convergence.");

- =====
- s. Regarding claim 17:
 - t. Press appears to teach:
 - i. It is determined whether the solution has converged after each iteration of the relaxation operation (pages 855, Relaxation Methods for Boundary Value Problems; second paragraph, section that starts with "Thus the algorithm consists . . .", sentence, "This procedure is then iterated until convergence.");
- =====

- u. Regarding claim 18:
 - v. Press appears to teach:
 - i. It is determined whether the solution has converged after a predetermined number of multiple iterations of the relaxation operation (pages 855, Relaxation Methods for Boundary Value Problems; second paragraph, section that starts with "Thus the algorithm consists . . .", sentence, "This procedure is then iterated until convergence.");
- =====

- w. Regarding claim 22:
 - x. Press appears to teach:
 - i. If it is determined that the solution has converged repeating the processing using an altered parameter value operation (pages 862-868, section 19.6 Multigrid Methods for Boundary Value Problems; it would have been obvious to altering a grid size is altering a parameter);
- =====

- y. Regarding claim 23:
- z. Press appears to teach:

- i. The number of iterations of the relaxation operation is determined prior to the processing (pages 860, Relaxation Methods for Boundary Value Problems; code example with a parameter value MAXITS = 1000 and a loop DO N=1,MAXITS);

=====

aa. Regarding claim 27:

- i. Claim 27 is taught as in claim 1 above.
- =====

8. Claims 19 - 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Press and Trendall as applied to claims 1 - 2, 12 - 18, 22 - 23 and 27 above, further in view of Roy-Chowdhury (Roy-Chowdhury, Amber; Bellas, Nikolas; Banerjee, Prithviraj; "Algorithm-Based Error-Detection Schemes for Iterative Solution of Partial Differential Equations", 1996, IEEE Transactions on Computers, Vol. 45, No. 4).

a. Regarding claim 19:

b. Press does not specifically teach:

- i. The determining whether the solution has converged includes calculating errors;

c. Roy-Chowdhury appears to teach:

- i. The determining whether the solution has converged includes calculating errors (page 400, left-side column, top-half);

d. The motivation to use the art of Roy-Chowdhury with the art of Press would have been the benefit recited in Roy-Chowdhury that the presented algorithm-based fault tolerance is an inexpensive method of achieving fault tolerance without requiring any hardware modifications, especially for iterative solution of linear systems arising from discretization of partial differential equations (page 394, Abstract).

- e. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Roy-Chowdhury with the art of Press and Trendall to produce the claimed invention.

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- f. Regarding claim 20:
- g. Press does not specifically teach:
- i. The determining whether the solution has converged further includes summing the errors;
- h. Roy-Chowdhury appears to teach:
- i. The determining whether the solution has converged further includes summing the errors (page 400, left-side column, top-half);

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- i. Regarding claim 21:
- j. Press does not specifically teach:
- i. Concluding that the solution has converged if the error is less than a predetermined amount;
- k. Roy-Chowdhury appears to teach:
- i. Concluding that the solution has converged if the error is less than a predetermined amount (page 400, left-side column, top-half);

=====

9. Claims 3 - 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Press and Trendall as applied to claims 1 - 2, 12 - 18, 22 - 23 and 27 above, further in view of Weiskopf (Weiskopf, Daniel; Hopf, Matthias; Ertl, Thomas; "Hardware-Accelerated Visualization of Time-Varying 2D and 3D Vector

Fields by Texture Advection via Programmable Per-Pixel Operations", 2001, Proceedings of the Vision Modeling and Visualization Conference 2001).

- a. Regarding claim 3:
- b. Press does not specifically teach:
 - i. the input includes textures;
- c. Weiskopf appears to teach:
 - i. the input includes textures (pages 668 - 669, section 3 Hardware-Based 2D Texture Advection; and page 668, figure 1, box "Load flow to texture Tv; it would have been obvious that the input includes textures; please note that the partial differential equation on page 667, right-side column, second paragraph, is being solved);
- d. The motivation to use the art of Weiskopf with the art of Press and Trendall would have been the benefit recited in Weiskopf that an advantage of the invention is extremely high simulation speed (page 672, right-side column, fourth paragraph that starts with "An advantage . . .").
- e. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Weiskopf with the art of Press and Trendall to produce the claimed invention.

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- f. Regarding claim 4:
- g. Press does not specifically teach:
 - i. the input includes geometry;
- h. Weiskopf appears to teach:
 - i. the input includes geometry (pages 668 - 669, section 3 Hardware-Based 2D Texture Advection; it would have been obvious that the input includes geometry; please note that the partial differential equation on page 667, right-side column, second paragraph, is being solved);

=====

- i. Regarding claim 5:
- j. Press does not specifically teach:
 - i. the geometry is selected from the group consisting of polygons, vertex data, points, and lines;

- k. Weiskopf appears to teach:
 - i. the geometry includes points (pages 668 - 669, section 3 Hardware-Based 2D Texture Advection; it would have been obvious that the input includes geometry; please note that the partial differential equation on page 667, right-side column, second paragraph, is being solved);

=====

- l. Regarding claim 6:
- m. Press does not specifically teach:
 - i. the input includes a local area of textures;
- n. Weiskopf appears to teach:
 - i. the input includes a local area of textures (pages 668 - 670, section 3 Hardware-Based 2D Texture Advection; it would have been obvious that the input includes a local area of textures; please note that the partial differential equation on page 667, right-side column, second paragraph, is being solved);

=====

10. Claims 7 - 11 and 24 - 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Press and Trendall and Weiskopf as applied to claims 3 - 6 above, further in view of Ewins (Ewins, Jon P.; Waller, Marcus D.; White, Martin; Lister, Paul F.; "MIP-Map Level Selection for Texture Mapping", 1998, IEEE Transactions on Visualization and Computer Graphics, Vol. 4, No. 4).

- a. Regarding claim 7:
- b. Press does not specifically teach:
 - i. the local area of textures is generated by sampling a texture map;
- c. Ewins appears to teach:
 - i. sampling a texture map (pages 318 - 319, section 1.1 Texture Filtering);
- d. The motivation to use the art of Ewins with the art of Press and Trendall and Weiskopf would have been the benefit recited in Ewins that texture mapping allows a high degree of visual

complexity without the expense of overly complex geometric modeling (page 317, section 1 Introduction, and Abstract).

e. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Ewins with the art of Press and Trendall and Weiskopf to produce the claimed invention.

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f. Regarding claim 8:

g. Press does not specifically teach:

i. the local area of textures is filtered;

h. Ewins appears to teach:

i. the local area of textures is filtered (pages 318 - 319, section 1.1 Texture Filtering);

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i. Regarding claim 9:

j. Press does not specifically teach:

i. the local area of textures is filtered utilizing a plurality of filters;

k. Ewins appears to teach:

i. the local area of textures is filtered utilizing a plurality of filters (pages 318 - 319, section 1.1 Texture Filtering);

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l. Regarding claim 10:

m. Press does not specifically teach:

i. the local area of textures is filtered utilizing filter including a plurality of elements;

n. Ewins appears to teach:

i. the local area of textures is filtered utilizing a filter including a plurality of elements (pages 318 - 319, section 1.1 Texture Filtering);

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o. Regarding claim 11:

p. Press does not specifically teach:

- i. the local area of textures is used to sample a texture map to generate a modified local area of textures;
 - q. Ewins appears to teach:
 - i. the local area of textures is used to sample a texture map to generate a modified local area of textures (pages 318 - 319, section 1.1 Texture Filtering);
- =====

- r. Regarding claim 24:
 - s. Press does not specifically teach:
 - i. the filtering is carried out using a programmable filter;
 - t. Ewins appears to teach:
 - i. the filtering is carried out using a programmable filter (pages 318 - 319, section 1.1 Texture Filtering);
- =====

- u. Regarding claim 25:
 - v. Press does not specifically teach:
 - i. the filtering is carried out using a non-programmable filter;
 - w. Ewins appears to teach:
 - i. the filtering is carried out using a non-programmable filter (pages 318 - 319, section 1.1 Texture Filtering);
- =====

11. Claims 26, 28 and 30 - 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Press (Press, William H.; Flannery, Brian P.; Teukolsky, Saul A.; Vetterling, William T.; "Numerical Recipes in C", 1988, Cambridge University Press) in view of Trendall (Trendall, Chris; Stewart, A. James; "General Calculations using graphics hardware, with application to interactive caustics", June 2000, "Rendering Techniques 2000: 11th Eurographics Workshop on Rendering").

- a. Regarding claim 26:
- b. Press appears to teach:

- i. Processing input (pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that input is required to solve a partial differential equation, especially given the statement that an initial distribution relaxes to an equilibrium distribution on page 673);
 - ii. Processing input to generate a solution to partial differential equations (pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems);
- c. Press does not specifically teach:
- i. A hardware graphics pipeline for processing input to generate a solution to partial differential equations.
- d. Trendall appears to teach:
- i. A hardware graphics pipeline for processing the input to generate the solution to a partial differential equation (page 1, Title; page 1, Abstract; page 1, section 1 Introduction; page 8, section 4.2 Hardware Algorithm; and page 2, section 2.2 Refractive Caustics; the solution of the caustic is a solution to an electromagnetic field problem described by a partial differential equation);
- e. The motivation to use the art of Trendall with the art of Press would have been the benefit recited in Trendall that calculations on functions or vector fields can be performed very quickly in graphics hardware (page 3, section 3 Mathematical capabilities of graphics hardware, third paragraph).
- f. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Trendall with the art of Press to produce the claimed invention.

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- g. Regarding claim 28:
- h. Press appears to teach:
- i. Receiving boundary conditions (pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that boundary conditions

are required to solve a partial differential equation, especially since the title of the section recites Boundary Value problems);

ii. Computing the solution to generate the solution to the partial differential equations involving the boundary conditions (pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems);

iii. Determining whether the solution has converged (page 674, first paragraph, subsection that starts with "Thus the algorithm . . .", sentence, "This procedure is then iterated until convergence.");

iv. If the solution has not converged, repeating the computing and determining (page 674, first paragraph, subsection that starts with "Thus the algorithm . . .", sentence, "This procedure is then iterated until convergence.");

i. Press does not specifically teach:

i. Computing the solution to generate the solution to the partial differential equations involving the boundary conditions at least some of the computing done in the hardware graphics pipeline;

j. Trendall appears to teach:

i. Receiving input in the hardware graphics pipeline (page 9, section 5 Implementation results, first paragraph; page 7, second paragraph that starts with "Since the imaging pipeline . . ."; it would have been obvious that in order for the pipeline to perform a convolution that input was received);

ii. Computing the solution to the partial differential equations at least some of the computing done in the hardware graphics pipeline (page 1, Title; page 1, Abstract; page 1, section 1 Introduction; page 8, section 4.2 Hardware Algorithm; and page 2, section 2.2 Refractive Caustics; the solution of the caustic is a solution to an electromagnetic field problem described by a partial differential equation);

k. The motivation to use the art of Trendall with the art of Press would have been the benefit recited in Trendall that calculations on functions or vector fields can be performed very quickly in graphics hardware (page 3, section 3 Mathematical capabilities of graphics hardware, third paragraph).

- l. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Trendall with the art of Press to produce the claimed invention.

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m. Regarding claim 30:

n. Press appears to teach:

- i. Receiving a first input (pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that input is required to solve a partial differential equation, especially given the statement that an initial distribution relaxes to an equilibrium distribution on page 673);
- ii. Processing the first input to generate a solution to a partial differential equation (pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems);

o. Press does not specifically teach:

- i. Receiving a first input into a hardware graphics pipeline;
- ii. Processing the first input to generate a solution to a partial differential equation utilizing the hardware graphics pipeline;
- iii. Receiving a second input into the hardware graphics pipeline;
- iv. Rendering the 3D graphics image utilizing the hardware graphics pipeline, wherein the rendering utilizes the second input and the result of the processing of the first input;

p. Trendall appears to teach:

- i. Receiving a first input into a hardware graphics pipeline (page 9, section 5 Implementation results, first paragraph; page 7, second paragraph that starts with "Since the imaging pipeline . . ."; it would have been obvious that in order for the pipeline to perform a convolution that input was received);
- ii. Processing the first input to generate a solution to a partial differential equation utilizing the hardware graphics pipeline (page 1, Title; page 1, Abstract; page 1, section 1 Introduction; page 8, section 4.2 Hardware Algorithm; and page 2, section 2.2 Refractive Caustics; the solution of the caustic is a solution to an electromagnetic field problem described by a partial differential equation);

- iii. Receiving a second input into the hardware graphics pipeline (pages 8 - 9, section 4.3 Heightfield generation; it would have been obvious that generating the heightfield used a second input into the hardware graphics pipeline);
 - iv. Rendering the 3D graphics image utilizing the hardware graphics pipeline, wherein the rendering utilizes the second input and the result of the processing of the first input (page 9, section 5; and especially page 13, figure 2);
- q. The motivation to use the art of Trendall with the art of Press would have been the benefit recited in Trendall that calculations on functions or vector fields can be performed very quickly in graphics hardware (page 3, section 3 Mathematical capabilities of graphics hardware, third paragraph).
- r. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Trendall with the art of Press to produce the claimed invention.

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- s. Regarding claim 31:
- t. Press appears to teach:
 - i. The first input comprises boundary conditions (pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that boundary conditions are required to solve a partial differential equation, especially since the title of the section recites Boundary Value problems);
 - ii. determining whether the solution has converged (page 674, first paragraph, subsection that starts with "Thus the algorithm . . .", sentence, "This procedure is then iterated until convergence.");
 - iii. If the solution has not converged, repeating the computing and determining (page 674, first paragraph, subsection that starts with "Thus the algorithm . . .", sentence, "This procedure is then iterated until convergence.");

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12. Claim 29 is rejected under 35 U.S.C. 103(a) as being unpatentable over Press (Press, William H.; Flannery, Brian P.; Teukolsky, Saul A.; Vetterling, William T.; "Numerical Recipes in C", 1988, Cambridge University Press) in view of Weiskopf (Weiskopf, Daniel; Hopf, Matthias; Ertl, Thomas; "Hardware-Accelerated Visualization of Time-Varying 2D and 3D Vector Fields by Texture Advection via Programmable Per-Pixel Operations", 2001, Proceedings of the Vision Modeling and Visualization Conference 2001), further in view of Roy-Chowdhury (Roy-Chowdhury, Amber; Bellas, Nikolas; Banerjee, Prithviraj; "Algorithm-Based Error-Detection Schemes for Iterative Solution of Partial Differential Equations", 1996, IEEE Transactions on Computers, Vol. 45, No. 4).

a. Regarding claim 29:

b. Press appears to teach:

- i. Receiving boundary conditions (pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that boundary conditions are required to solve a partial differential equation, especially since the title of the section recites Boundary Value problems);
- ii. computing the solution to the partial differential equation utilizing a relaxation operation involving the boundary conditions (pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems);
- iii. determining whether the solution has converged (page 674, first paragraph, subsection that starts with "Thus the algorithm . . .", sentence, "This procedure is then iterated until convergence.");
- iv. If the solution has not converged, repeating the computing and determining (page 674, first paragraph, subsection that starts with "Thus the algorithm . . .", sentence, "This procedure is then iterated until convergence.");
- v. if the solution has converged, incrementing a time value (page 658, second paragraph, sentence that starts, "To solve equation (17.2.8) . . ."); and
- vi. repeating the foregoing operations using the incremented time value (page 658, second paragraph, sentence that starts, "To solve equation (17.2.8) . . .").

c. Press does not specifically teach:

- i. Receiving boundary conditions in the form of at least one of geometry and textures;
 - ii. computing the solution to the partial differential equation utilizing a relaxation operation involving the boundary conditions at least some of the computing done in the hardware graphics pipeline;
 - iii. determining whether the solution has converged by:
 - (1) calculating the errors,
 - (2) summing the errors, and
 - iv. concluding that the solution has converged if the sum of errors is less than a predetermined amount;
- d. Weiskopf appears to teach:
- i. Receiving boundary conditions in the form of at least one of geometry and textures (pages 668 - 669, section 3 Hardware-Based 2D Texture Advection; and page 668, figure 1, box "Load flow to texture Tv; it would have been obvious that boundary conditions were loaded in the form of a texture; please note that the partial differential equation on page 667, right-side column, second paragraph, is being solved);
- e. Roy-Chowdhury appears to teach:
- i. determining whether the solution has converged by:
 - (1) calculating the errors (page 400, left-side column, top-half),
 - (2) summing the errors (page 400, left-side column, top-half),, and
 - ii. concluding that the solution has converged if the sum of errors is less than a predetermined amount (page 400, left-side column, top-half),;
 - iii.
- f. The motivation to use the art of Weiskopf with the art of Press would have been the benefit recited in Weiskopf that an advantage is extremely high simulation speed (page 3, section 3 Mathematical capabilities of graphics hardware, third paragraph).
- g. The motivation to use the art of Roy-Chowdhury with the art of Press would have been the benefit recited in Roy-Chowdhury that the presented algorithm-based fault tolerance is an

inexpensive method of achieving fault tolerance without requiring any hardware modifications, especially for iterative solution of linear systems arising from discretization of partial differential equations (page 394, Abstract).

h. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Weiskopf and the art of Roy-Chowdhury with the art of Press to produce the claimed invention.

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13. **Examiner's Note:** Examiner has cited particular columns and line numbers in the references applied to the claims above for the convenience of the applicant. Although the specified citations are representative of the teachings of the art and are applied to specific limitations within the individual claim, other passages and figures may apply as well. It is respectfully requested from the Applicant in preparing responses, to fully consider the references in their entirety as potentially teaching all or part of the claimed invention, as well as the context of the passage as taught by the prior art or disclosed by the Examiner.

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to the applicant's disclosure:

- a. Lengyel, Jed; Reichert, Mark; Donald, Bruce R.; Greenberg, Donald P.; "Real-Time Robot Motion Planning Using Rasterizing Computer Graphics Hardware", 1990, Proceedings of the 17th annual conference on computer graphics and interactive techniques; this reference demonstrates that it was old and well known to use graphics hardware programming to solve a non-graphics problem.
- b. Lindholm, Erik; Kilgard, Mark J.; Moreton, Henry; "A User-Programmable Vertex Engine", 2001, Proceedings of the 28th annual conference on computer graphics and interactive techniques;
- c. Ide, Nobuhiro et al.; "2.44 GFLOPS 300-MHz Floating-Point Vector-Processing Unit for High-Performance 3-D Graphics Computing", July 2000, IEEE Journal of Solid-State Circuits, Vol. 35, No. 7; this reference discusses the use of graphics hardware to perform physical simulation of physical equations (pages 1025 - 1026);
- d. Kedem, Gershon; Ishihara, Yuriko; "Brute force attack on UNIX passwords with SIMD computer", 1999, Proceedings of the 8th USENIX Security Symposium; this reference demonstrates that it was old and well known to use graphics hardware programming to solve a non-graphics problem by using the speed of the graphics hardware.
- e. Bohn, Christian-A; "Kohonen Feature Mapping through Graphics Hardware", 1998, 3rd International Conference on Computational Intelligence and Neurosciences; this reference demonstrates that it was old and well known to use graphics hardware programming to solve a non-graphics problem by using the speed of the graphics hardware.
- f. Harris, et al.; "Physically-Based Visual Simulation on Graphics Hardware", September 2002; Proceedings of the ACM SIGGRAPH/EUROGRAPHICS conference on Graphics Hardware; this reference points to earlier references related to visualization of flows by partial differential equations implemented using graphics hardware (page 111, top right quadrant).


15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Russell L. Guill whose telephone number is 571-272-7955. The examiner can normally be reached on Monday - Friday 10:00 AM - 6:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Leo Picard can be reached on 571-272-3749. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300. Any inquiry of a general nature or relating to the status of this application should be directed to the TC2100 Group Receptionist: 571-272-2100.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

RG

Russ Guill
Examiner
Art Unit 2123


Paul L. Rodriguez 2/14/06
Primary Examiner
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